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Beliefs hold by pre-school prospective teachers toward mathematics and its teaching

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Abstract

The purpose of this study was to investigate the beliefs held by pre-school prospective teachers toward mathematics and its teaching and the changes in their beliefs (if any) following their participation in a one semester course. 166 prospective teachers were asked to fill in an open-ended questionnaire at the beginning and at the end of the course. Data analysis shows that many prospective teachers hold negative beliefs toward mathematics, but less negative beliefs toward its teaching in pre-school. Comparison of the two questionnaires shows an improvement in the way prospective teachers refer to mathematics and its teaching.

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Keywords: Mathematical concepts; beliefs; prospective teachers; pre-school education, early learners

1. Introduction

Mathematics is important as it is a major part of our everyday life. Almost everything we do has something to do with mathematics, for example: shopping involves not only the knowledge of adding and subtracting, but also the ability to estimate the sums and to understand percentages; arriving on time for a meeting involves estimation of time; for finding an address one has to be aware of the buildings' numbers; ordering furniture to our house needs some pre-measuring. Also, citizens in our modern society, who want to understand what is written in the newspapers or what is shown on the television news need to understand mathematics, since many such items include graphs, percentages and other concepts taken from mathematics. Moreover, mathematics is well known as having the potential to develop thinking, logic, creativity and problem solving skills.

Mathematics is learned all around the world from first to twelfth grade. It is also part of the activities children are engaged in during pre-school. Unfortunately, many students during school time and as adults after finishing school hate mathematics and some even suffer from mathematics anxiety. Math anxiety is expressed by a feeling of fear, tension and panic when asked to perform mathematical tasks. This kind of feeling may prevent students from choosing careers which require math classes. "Highly math-anxious individuals are characterized by a strong tendency to avoid math, which ultimately undercuts their math competence and forecloses important career paths". (Ashcraft, 2002, p. 181).

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The basis for mathematics is formatted in early childhood. Upon this basis the child will develop mathematical concepts at school. A strong and accurate mathematical basis will enable the child to progress in mathematics. An unstable basis might prevent him from building solid mathematical knowledge and might contribute to math anxiety later on. Since the first engagements with mathematical activities occur in pre-school, it is crucial that pre-school teachers have positive attitudes toward mathematics. Positive attitudes are the first step needed for teachers to engage their children in mathematical activities. Research suggests that among early childhood prospective teachers, there are teachers who hold negative beliefs toward mathematics and who suffer from math anxiety (e.g., Gresham, 2007; Zacharos et al., 2007). In addition, pre-school teachers need to hold such beliefs about the nature of mathematics, which will allow them to teach mathematics in a proper way (e.g., Lee, 2006; Lee & Ginsburg, 2009). Research suggests that there is a relationship between teachers' beliefs toward mathematics and between the way children practice mathematics (e.g., Ng et al. 2003). Teachers also need to posses subject matter knowledge so they can teach mathematics correctly to children, and to have pedagogical subject matter knowledge in order to be able to engage young children in the learning of mathematics. Research shows that negative beliefs can be reduced as a result of the participation in carefully developed courses (Gresham, 2007). The mathematical courses and the field practice pre-school prospective teachers are engaged with, during their years of study, are very important in shaping their beliefs toward mathematics and in reinforcing their mathematical knowledge.

This study focuses on the beliefs held by prospective pre-school teachers toward mathematics and its teaching. The purpose of the study was to reveal the beliefs and the changes in their beliefs (if any) of the prospective teachers, following their participation in a one semester course called "The development of mathematical concepts in early childhood".

2. Method

Population – 166 prospective pre-school teachers participated in this research. They where in their first year of study, and had to complete four years in order to receive the degree of pre-school teachers. During their four years of study they learn two courses related to mathematics. The first, a one semester course called "The development of mathematical concepts in early childhood" (which was a part of this study). The second, a two semester course called "Teaching mathematics for young children", which is a didactic course.

The course – The course "The development of mathematical concepts in early childhood" aims: a. to introduce the way young children develop mathematical concepts and to discuss the way the pre-school prospective teachers themselves developed their mathematical concepts; b. to solve riddles using different problem solving strategies; c. to study a mathematical topic and take an exam on this topic; d. to explore the understanding of mathematical concepts among young children by doing field interviews. The course is a one semester course which includes 13-14 sessions, of two academic hours each. During the first 7 sessions we discussed some theories and looked at some examples regarding the way mathematical concepts are developed. Each of these meetings started with a mathematical riddle. The next 4-5 meetings were devoted to study some concepts of the mathematical topic called "Set Theory". This topic was chosen for two reasons. The first – it is a new topic for almost all students, so they all had a fresh start. The second – sets appear in our new National Mathematics Curriculum (2009) for ages 3-6, and it is important for the prospective teachers to have some knowledge in this area. At the end of these meetings the prospective teachers took a short exam. The main purpose of the exam was to show the participants that they can deal with mathematics, can take mathematical exams and can receive good grades in mathematics. For many of them this exam served as some kind of correction for their fear and anxiety toward mathematics. In the last 2-3 sessions the participants presented their field interviews with children. (This assignment was prepared by groups of 3-5 students. Each group received interview items on a different mathematical concept and each participant was asked to interview 5 children).

The questionnaires - Two similar questionnaires were distributed: The first, on the first meeting of the course and the second on the last meeting (the second questionnaire included, in addition, some questions regarding the course itself). The first two questions were open-ended:

1. What is the first thing that comes to your mind when you hear the word mathematics?
2. What do you think mathematics is?

Two questions were presented on a 1-5 scale and asked for an explanation as well:

1. Do you love or do you hate mathematics? Explain your choice.
2. Do you think you will enjoy teaching mathematics to young children? Explain your choice.

The last question referred to the need they see in their learning of mathematics:

1. Do you think you need to learn mathematics in order to teach mathematics to young children? Yes / No. Explain your answer.

3. Results

The questions were analyzed quantitatively and qualitatively (by using categories for the open-ended questions). The results are presented for each of the questions.

Question 1 – First thing that comes to mind when hearing the word mathematics.

Table 1 presents the answers given before and after the course. As can be seen, for 35% of the participants, before the course, the word mathematics had bad connotations. 21% seemed to suffer from math anxiety, saying that the first thing that comes to mind when hearing the word math is: "Stress; Nightmare; Horrible; Headache; Oh God!; Dizziness; My body is shaking; etc.". For others mathematics reminded difficulty. These feelings are probably part of their experience with math during their school years. After the course these percentages were reduced by about a half and only 18% expressed negative feelings toward mathematics. Moreover, after the course, 10% of the participants said that mathematics is less scary. These results suggest that the course did have an influence on participants' beliefs toward mathematics. About one half of the participants said that the word mathematics reminded them numbers, exercises, equations, etc. For very few, when they hear about mathematics they think of fun, creativity, success, challenge or of everyday life. Although these percentages were raised a little after the course it seems that the course did not have the power to make the connection between mathematics and these notions among the participants.

Table 1 – Results for Question 1

Category	Before the course	After the course
Deep hate, fear, stress, trauma, etc.	21%	10%
Complication, hardness, do not like	14%	8%
Different words connected to math: numbers, equations, etc.	58%	51%
Thinking, challenge, creativity	4%	11%
Fun, pleasure, success	2%	6%
Everyday life	1%	4%
Less scary	-	10%

Question 2 – What is mathematics?

Table 2 presents prospective teachers' responses to the question of what mathematics is. It can be seen that since the question was about mathematics and not about their personal feelings about mathematics, the answers were different than those given in the previous question. In this question only few expressed negative feelings; more (compared to question 1) suggested that mathematics is numbers, operations, equations, etc., and more connected mathematics to everyday life. These results make even stronger the results for question 1, suggesting that when asked to reveal their own feeling about mathematics, and not just relate to mathematics, their negative feelings came out.

Table 2 – Results for Question 2

Category	Before the course	After the course
Something that people hate	1%	1%
Complication, difficult, boring	5%	5%
Different words connected to math: numbers, equations, etc.	74%	61%
Thinking, challenge, creativity, understanding	9%	11%
Fun, pleasure, success	1%	2%
Important for everyday life	10%	20%

Question 3 – Love or hate of mathematics

On a scale of 1-5 the mean before taking the course was 2.92, a little less than the possible average (3). Many of the explanations showed bad experiences with mathematics the participants had as students in school. For example: "*The experience I had with mathematics during the years was a bad one and left me with an "anti" regarding mathematics*" (chose No. 1 on the scale). Or: *"Can't see numbers. They make me dizzy*" (chose No. 1 on the scale). Or "*In the area of mathematics I was never able to express my knowledge, I did not succeed to reach any achievements"* (chose No. 1 on the scale). Or: "*The teacher in junior high was a witch and the teacher in high school was a king"* (chose No. 3 on the scale). Others expressed better feelings. For example: "*I can manage with mathematics*" (chose No. 4 on the scale). Or: *"I like numbers"* (chose No. 4 on the scale). Or: "*It seems I am good at math, it interests me and it is important to know math"* (chose No. 5 on the scale). After the course the mean was raised to 3.46 with a significant difference compared to the mean before the course ($p<0.001$), suggesting a huge change in participants' feelings toward mathematics.

Question 4 – Enjoy teaching mathematics to young children

Although many participants hold negative feeling toward mathematics, their feelings about teaching mathematics in pre-school were positive. The mean before the course on a scale of 1-5 was 4.07 and was increased to 4.36 after the course ($p< 0.01$). It seems that the activities included in the course caused the participant to improve their feelings toward the teaching of mathematics. Most of their explanations lean on their understanding that the math in pre-school is basic and they will be able to deal with it. Others emphasized the importance of mathematics to the children. For example: "*It is more simple and understandable, explained in a much easier way and not in a terrible way as it is done in school"* (chose No. 4 on the scale). Or: "*I personally do not like math. But maybe through the children I will learn to love it"* (chose No. 3 on the scale). Or: *"If I do not know and I hate it I might pass this to the children even if I do not want to"* (chose No. 4 on the scale). Or: *"I think it is fascinating to listen to children's answers and to teach them the concepts. Moreover it is very important for the children"* (chose No5 on the scale).

Question 5 – Need for learning mathematics

Most of the participants agreed that they should learn mathematics as part of their studies – 88% before the course and 92% after the course. It seems that their explanations before the course were directed mainly to the fact that they need to know how to teach mathematics to young children, while after the course they realized that they also need to learn the subject matter itself. For example: "*Because there are definitions which I understood in a certain way until now and I learned the correct definitions in the course and it is important to teach the children accurate definitions"*. Or: *"Mathematics is one of the most important areas to deal with in pre-school. We as prospective teachers need to have a certain amount of knowledge in math as to build the children's solid foundations in this important area"*.

3. Discussion

In this study we revealed prospective pre-school teachers' beliefs toward mathematics and its teaching. We found that many of the pre-school prospective teachers hold negative feelings about mathematics. In most of the cases these feeling are connected with their school experiences, which in many cases turned mathematics into a difficult subject, connected with failure, a subject which is unclear and unnecessary to study. Since mathematics is a part of children's everyday life in pre-school, those teachers are expected to teach mathematics and to do it in such a way that children would like and understand it. Prospective teachers' beliefs toward mathematics might have a major impact on how and how much the children in their pre-schools will be engaged in mathematical situations.

Following a one semester course we found overall changes in participants' beliefs. Fewer participants expressed math anxiety, or said that they hate math, and more said they will enjoy teaching math to pre-school children. These results suggest that the course "The development of mathematical concepts in early childhood" did make a difference for many of the participants. The following answers to question 3 (love or hate math) express a dramatic change in beliefs of one prospective teacher: Before the course she chose no. 1 to express her hate to mathematics and explained that "*I do not connect with numbers and with rules one has to follow. I like literature and history and hate mathematics."* After the course she chose no. 4 on the scale and said "*I never liked mathematics. I did not like too much to think and I did not bother to learn and understand. During the course I understood and succeeded and was amazed that I can like mathematics, although I still have some difficulties with problems which might be a little confusing, that is why I did not choose 5"*.

Although for many participants the course caused positive changes in their beliefs toward mathematics and its teaching, still, after the course, 10% of the participants expressed math anxiety. It is clear that a one semester course, although causing a huge change, cannot do magic and eliminate completely math anxiety. It is also clear that all pre-school teachers need to have positive feelings toward mathematics, to know mathematics to a certain level and to realize that mathematics can and should be taught in such a way as to challenge the children. Teacher educators need to take all these factors into consideration when making decisions regarding the curriculum for prospective teachers. Prospective pre-school teacher educators and policy makers around the world should devote more thinking to the quantity and the contents of the courses needed in order to prepare prospective early childhood teachers to teach mathematics in pre-school.

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